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Studies in Logopedics, Phoniatrics and Audiology No 5
Lund University

Prosody in Swedish children with Language Impairment

Perceptual, Acoustic and Interactional Aspects

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From the Department of Logopedics, Phoniatrics and Audiology
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Lund 2004

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List of papers

This thesis is based on the following papers:

- I Samuelsson, C., Scooco, C. & Nettelblatt, U. Towards assessment of prosodic abilities in Swedish children with language impairment. *Logopedics Phoniatics Vocology*; 28:156-166, 2003
- II Samuelsson, C. & Nettelblatt, U. Prosodic problems in Swedish children with language impairment: towards a classification of subgroups. *International Journal of Language and Communication Disorders*. vol 39, no 3:325-344, 2004
- III Samuelsson, C. & Löfqvist, A. The role of Swedish tonal word accents in children with language impairment. Accepted for publication in *Clinical Linguistics and Phonetics*, 2004
- IV Samuelsson, C., Nettelblatt, U. & Löfqvist, A. Prosody at the discourse level in Swedish children with language impairment. Submitted for publication, 2004.

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Background

Introduction

Prosody carries a lot of information relevant for our understanding of spoken messages. In addition, prosody plays an important role in signalling attitudes and emotions. However, prosody is elusive to its character and therefore difficult to describe with a single definition. Prosody can be described as the rhythmic, dynamic and melodic features of language. Prosody is complex due to several factors: it is multifaceted, there is no one-to-one correspondence between prosody and specific linguistic meaning, prosody can be redundant and there is no direct correspondence between perceptual judgements and instrumental measures (Hargrove & McGarr, 1994). Swedish has a complicated prosodic system compared to e.g. English and a surprisingly large proportion of Swedish children with language impairment have prosodic problems to some extent.

Prosodic problems are not a diagnosis *per se*, but symptoms that occur at different levels of language. Prosodic problems also exist in several deficits of speech and language ability. The overall purpose of the present work is to explore prosodic problems in Swedish children with language impairment. This means that in this thesis the issue is a symptom and not a specific subcategory of language impairment, which is the perspective of most previous research in Swedish children with language impairment. In this thesis I try to emphasize the importance of adopting different perspectives on language impairment, both in research and in clinical work. This is of particular importance in the discussion of classification where I argue that a more dimensional view than what is offered within the current system of classification, ICD-10, is preferred. This is in accordance with Bishop (2004).

In previous research on Swedish children with language impairment, prosody has not been the main focus. Thus, there were no established methods for assessing prosody at our disposal when starting out this thesis project. The development of new assessment methods is of major importance to increase the accuracy of description of the problems. Thereby it also increases the possibilities of more exact methods for intervention. The present work will hopefully contribute to a greater understanding of the role of prosodic phenomena in different dimensions of language impairment. The following sections are included below: language impairment, prosody and analyses.

Language impairment

This section contains a historical background in order to provide a perspective on the classification of language impairment and on the means to describe and diagnose prosodic problems. Definitions and criteria will also be described in some detail as well as the current systems of classification in clinical use. A section on underlying factors of language impairment is also included. Prosody in general and especially prosodic problems will be described in depth later in their own section of the background.

History

Today, the range of phenomena comprised by the term language impairment in children, is well established and recognized. Attempting to understand how language impairment has appeared in different ways during different periods is of great importance for the understanding of definitions and classifications. That language impairment in children has come into focus at certain points in time may depend on different contemporary societal factors. Specific theories make us highlight certain phenomena and ignore others. Theories change over time and so do classifications of language impairments. The earliest known description of language impairments in children dates back to 1835 and was

made by the Austrian physician Franz Joseph Gall (Nettelbladt, 1998a). One important contribution by Gall was the differentiation between children with language impairment and children with a general mental retardation. It was not, however, until the last decades of the 19th century that child language impairment was established as a topic in its own right. This is evidenced by a large number of publications, written almost without exception by German or Austrian physicians, specialized in the newly established discipline of otorhinolaryngology. This group of physicians is sometimes referred to as 'die Sprachärzte' indicating that they constituted a new profession specialized in language impairments in children (for example Liebmann, 1898; for more details, see Nettelbladt & Samuelsson, 1998).

In Sweden the initiation of assessing language impairment in children was mainly made by the female physician Alfild Tamm who established the Clinic for Speech Impairment in the elementary schools of Stockholm, Sweden (Polikliniken för talrubbningar vid Stockholms stads folkskolor) in 1914. Library searches show an impressive list of publications by Tamm on the subject of language impairment and dyslexia in children (Samuelsson, 1999). Early on, she published a textbook titled "Speech impairments and their treatment" (=Talrubbningar och deras behandling; Tamm, 1916). She also applied a system for classification of speech and language impairment in children, which had been developed by one of 'die Sprachärzte', Albert Liebmann in Berlin, to Swedish. Within this system a differentiation was made between articulation errors and the so called "Hörstummheit" (=audiomutitas), a more severe kind of disorder involving both phonological and grammatical disorders (Nettelbladt & Samuelsson, 1998). A differentiation was also made between stuttering and cluttering. To both Liebmann and Tamm the search for etiological factors was important and, as a consequence, they separated motor from sensory "Hörstummheit" (Tamm, 1912). Influenced by her teacher in neurology,

Salomon Henschen, Tamm also applied contemporary aphasiology, especially theories on the localisation, on language impairment in children. The work by Alfild Tamm has until recently almost completely fallen into oblivion, but her life and work has been described in a biography by Fritzell (2003).

After Tamm there were almost no Swedish publications on language impairment in children until the 1960's. During the 1960's research on child language acquisition in general was initiated internationally and, subsequently, also research on language impairment. This break-through was made possible by two important theories, i.e. the theory on phonological development by Jakobson (published in German in 1941, translated into English in 1968) and Chomsky's generative grammar (1965). Jakobson's theory was the first linguistically based theory to be applied in Sweden to the area of child language impairment in children (Nettelbladt, 1983; 1997). Two licentiate dissertations were presented at Lund University in 1969. Söderpalm (1969) described the phonology of 37 children diagnosed as language impaired. Bergendal (1969) described how language impairment can be manifested in both speech and writing. Both Söderpalm and Bergendal hold the view that it is important to make a distinction between articulation on the one hand, and the child's phonological system on the other hand.

During the 1980's and 1990's several different theoretical perspectives on language impairment in children influenced Swedish research and clinical work. Of great importance was the introduction of phonological analysis in terms of phonological processes (Ingram, 1979; Nettelbladt, 1983; Magnusson, 1983). The role of syntactic analysis in the assessment of children with language impairment was pointed out by Crystal, Fletcher & Garman (1976) and, according to Nettelbladt (1997), this gave legitimacy to the linguistically oriented research in child language impairment. Gradually syntactic analysis

was also introduced into clinical use (K. Hansson, 1998). Cognitive theories and neuropsychology also influenced the theories of language impairment in children. A neurolinguistic perspective in the assessment of children with LI was described by Sahlén (1991). The role of cognitive processing was also emphasized. By the end of the 1990's, theories of working memory were applied in Swedish research on children with LI (Sahlén, Reuterskiöld-Wagner, Nettelbladt and Radeborg, 1999). Bates (1976) contributed with a pragmatic and sociolinguistic perspective. During the 1980's and the 1990's pragmatics became a widely discussed aspect of language impairment. The terminology used in research and in clinical work reflects the current view on language impairment in children. The societal development also influenced in what way these children were assessed. During the 1980's, the Swedish child health care received a stronger position through the health legislation and this meant that children followed the health care program to a greater extent than what they previously did (Sämfors 2001). The fact that most Swedish children were examined regarding psycho-social development made it possible to detect children with LI earlier than before. However, the views on normality in relation to impairment and handicap also vary throughout different epochs; the ICF system of classification described below takes the problem of normality into account.

Definition and criteria

The identification of children with specific language impairment (SLI) is a challenging task for both researchers and clinicians (Botting & Conti-Ramsden, 2004). SLI is a heterogeneous disorder, currently used to describe children with otherwise normal development and normal hearing, exhibiting a significant deficit in the production and/or comprehension of language (Leonard, 1998). The diagnosis of SLI can be made according to three types of criteria; exclusionary criteria, inclusionary criteria and discrepancy criteria. Using

exclusionary criteria, there should be no obvious reason for the language impairment (Stark & Tallal, 1981; Bishop, 1997; Leonard, 1998). This means that the children should have normal non-verbal intelligence, normal hearing, normal neurological development and normal socio-emotional development (K. Hansson, 1998). The exclusion of children with phonological problems only is strange, but according to Leonard (1998) it might come from the previous view where developmental dysphasia was sharply distinguished from problems in articulation of which phonology was an obvious part (Leonard, 1998). According to these exclusionary criteria children with pragmatic problems do not fit into the diagnosis of SLI either, even though it has been shown that pragmatic problems occur in combination with SLI (Frazier Norbury, Nash, Baird & Bishop, 2004). Inclusionary criteria imply that the children shall meet certain results or cut off scores on language tests or present certain features in their spontaneous speech. Bishop (1997) states that there is no consensus whether SLI is a uniform diagnosis or if it is a heterogeneous group comprising a number of different language disorders. According to discrepancy criteria, children with SLI should perform significantly inferior on language tests than on nonverbal tests and their achievements should also be significantly lower on language tests than children of the same age.

However, for clinical diagnoses the need for such strict criteria for SLI is less evident, as a diagnosis is used as an indication of whether a child needs and/or would benefit from intervention or not. When using less strict criteria, Bishop suggests that the term Language Impairment (LI) be used instead (Bishop, 1997). According to Bishop (2004:311), “a crucial part of any sensible clinical definition of SLI must be that the language interferes significantly with communication in everyday life.” Phonological problems do not meet the criteria of SLI but can still cause major problems in everyday life. In addition, children with phonological problems often respond very well to therapy. In this

thesis the term LI will be used. As prosodic problems appear at different levels of language and in different diagnoses with various degrees of severity, the subjects of the present study were included according to very wide criteria. However, all subjects had a diagnosis of LI defined in accordance with Swedish clinical practice and also with the International Classification of Diseases (ICD-10).

Systems of classification

In Swedish clinical practice, different subgroups of LI are categorized mainly according to ICD-10, which is the contemporary International Classification of Diseases published by the World Health Organization. The Swedish translation has been in clinical use since 1997. The ICD system for classification of diseases has a century-old history and it is revised approximately every ten years. The ICD system was preceded by the work of Sauvages (1706-1777), *Nosologia methodica*, which is an attempt to classify diseases systematically and also the *Genera morborum* by the Swedish taxonomist Linnaeus (1707-1778). At the beginning of the 19th century, the classification of diseases published under the title *Synopsis nosologiae methodicae* by Cullen (1710-1790) was the one in most general use. The medical statistician Farr (1807-1883) revised the work of Cullen and the general arrangement proposed by Farr formed the basis of the International List of Causes of Death. Later on, in his *Report on nomenclature and statistical classification of diseases*, Farr included not only fatal diseases but also those diseases that affect health (ICD-10, vol.2). In ICD-10, which is the tenth version of the classification, the different sub-diagnoses of LI are categorized under the main heading of disorders of psychological development. The system is descriptive, based on linguistic symptoms. The subgroups included in the classification are: Specific developmental disorders of speech and language, Specific speech articulation disorder, Expressive language disorder, Receptive language disorder, Acquired aphasia with epilepsy [Landau

Kleffner syndrome], Other developmental disorders of speech and language and Developmental disorder of speech and language, unspecified. In the older version, ICD-9, the LI subgroups were categorized not only from symptomatology, but etiological factors such as heredity were also taken into consideration.

In the psychiatric system of classification, DSM-IV (1994), different subgroups of LI are also described. This system is not in clinical use amongst Swedish speech language clinicians, but it offers some rather useful details for guidance in diagnosing children with LI. In DSM-IV there are three subgroups of communication disorders: expressive language disorder, mixed receptive-expressive language disorder and phonological disorder. Each diagnosis is described, and associated features are listed as well as differential diagnoses. One example of associated features of expressive language disorder is environmental deprivation. Further, pervasive developmental disorder or mental retardation are suggested as differential diagnoses. Possible aetiologies of each diagnosis are also mentioned.

Recently, a complement of the ICD system has come into use mainly in psychiatric and neurological rehabilitation; the International Classification of Functioning, Disability and Health, ICF. This was translated into Swedish in 2003. The overall purpose of this classification is to offer a standardized structure to describe functions and disabilities in relation to health. If the ICD diagnosis is supplemented with information about the functional level described in ICF, we might get a broader view on people's health (Hartelius, manuscript). A shift in focus from classifying language impairment as an individual disability to increased attention to communicative activity and environmental factors in the child's context, gives a more differentiated and complex description of LI.

This system of classification has not yet come into clinical use amongst Swedish clinicians.

Underlying factors

There are two major directions in the theories of underlying factors of LI (for an overview, see Leonard, 1998; Nettelbladt, 1998b; K. Hansson, 1998). In one of these theories it is assumed that there is a *deficit of linguistic knowledge* and most of these theories spring from earlier Chomskyan theories. It is claimed that children have problems with functional categories, or that their grammar lacks the features necessary for rule construction. It is also argued that children are not aware of the fact that tense marking is obligatory and that children with LI stay in this stage longer than normally developing children do.

In the other direction it is claimed that children with LI have *language processing limitations*. Within this view it is assumed that children with LI have limitations in their general processing capacity. It is also claimed that the nonverbal cognitive skills of these children are not as normal as usually argued. There are also different models within this direction, e.g. the surface hypothesis, in which it is assumed that the problems of children with LI are due to perceptual limitations, in particular related to the speed of processing. According to another account, the sparse morphology account, the structure of the target language determines how the language impairment is manifested. Learning a language where morphology carries a lot of relevant information should cause fewer problems with morphology than learning a language where morphology carries less crucial information.

Another hypothesis of particular interest for prosody is the metrical hypothesis originally proposed by Gerken (1991). This theory posits that young children aim at a strong-weak (trochaic) rhythmic pattern. It is thus more likely that the

iambic word pattern in “guitar” is reduced to “tar” than the trochaic pattern “trumpet” to “trum”. The metrical account also covers reductions within the phrase. Young children are more likely to omit, for instance, an article than an inflection. In a phrase like “He plays the flute” the child will say “plays flute”. According to international research both English and Italian children with language impairment tend to omit syllables that violate the strong-weak pattern (Leonard, 1999; Leonard & Bortolini, 1998). In a study exploring the use of indefinite articles and definite suffixes in Swedish children with impaired and typical language development it was shown that Swedish children also tend to omit unstressed elements (K. Hansson, Nettelbladt & Leonard, 2003).

Prosody

This section contains a description of prosody, in particular Swedish prosody. There is also a brief account of different theories to explain phonological development including prosodic development. Finally, there is also a short survey of research findings on prosody in Swedish children with LI.

A common subdivision of the sound properties of a language is to identify three main classes: vowels, consonants and prosody (Bruce, 1998:9). Prosody is a linguistic universal manifested in different ways in different languages (Panagos & Prelock, 1997). Prosody can be characterized as the rhythmic, dynamic and melodic features of language. The acoustic-phonetic properties related to these features are duration, intensity and pitch (Bruce, 1998). One of the main functions of prosody is to provide the organizational framework of the spoken message. The functions of prosody include:

- a) distinctive functions, e.g. word tones
- b) prominence, e.g. focusing a syllable in a word (stress) or a word in a phrase (focus)
- c) grouping, e.g. distinct phrasings
- d) discourse functions such as pitch agreement or signalling emotions

Swedish prosody

Compared to English, Swedish has a relatively complicated prosodic system. It is often referred to as a pitch accent language (Cruttenden, 1997). There are contrasts of vowel quantity, word stress, i.e. initial vs. non-initial stress, as well as of tonal word accents. In Swedish, there are a few hundred minimal pairs distinguished by tonal word accent alone (Elert, 1966), e.g. /t̪ ɔmtɛn/ - /t̪ ɔmtɛn/ ("the lot" - "Santa Claus"). However, the choice of word accent is largely predictable from the morphological structure of the word. Words with monosyllabic stems take accent I and words with bisyllabic stems accent II. A pioneering survey of tonal word accent F0 contours was made by Meyer (1937) and these contours have proved useful in establishing accent-based dialect typologies (Gårding, 1977; Öhman, 1967). The difference between accent I and accent II in Swedish can be described as a difference in the timing of the tonal gesture in relation to the beginning of the stressed syllable (Bruce, 1977). Accent II requires a series of at least two syllables and consequently the contrast between accent I and II never occurs in monosyllabic words (Engstrand, 1997). The phonetic correlate of accent II has been described as a two-peaked fundamental frequency contour (Malmberg, 1963), but the second peak is not always present. There is no difference in the degree of prominence between accent I and II. Rather, they are phonological properties of individual word forms. The word accent distinction is also maintained in non-focal position (P. Hansson, 2003). Previous studies have shown that the presence of an initial peak

and fall in the F0 contour of accent II is a rather robust pattern, while there is more variability of the accent I-pattern (Engstrand, 1995; 1997).

Not many languages in the world use quantity distinctively. Examples of such languages are Russian and Greek. In Germanic languages, quantity is limited to stressed syllables. In Swedish, the domain of the distinction of quantity is the rhyme of the syllable (except for southern Swedish). In a stressed syllable, Swedish has a combination of either long vowel and a short consonant [V:(C)] or short vowel and long consonant or consonant cluster [VC:(C)]. This concerns stressed/heavy syllables while unstressed/light syllables lack distinction of quantity (Bruce, 1998).

Word-stress is used in different ways in the languages of the world. Many languages have so-called fixed word-stress, e.g. Finnish and Turkish. In such languages, stress takes on a strong demarcative function. Swedish uses word-stress distinctively in a less predictive way like e.g. Russian. In Swedish a number of minimal pairs can be found where the placement of stress is distinctive e.g. /'trʌmpɛt/ - /trum'pɛ:t/ ("sullenly"-“trumpet”). However, the placement of stress is not the only difference between these words since the quality of both consonants and vowels is affected by stress (Bruce, 1998; Cruttenden, 1997).

Theories to explain phonological development including prosodic development

Language development in general, and especially prosodic development, is influenced by the ambient language. It has been shown that prosodic and vocalic properties in infant-directed speech are adapted to the developing child's communicative needs and constraints (Sundberg, 1998). Language input to infants has culturally universal characteristics that facilitate language learning (Kuhl, Andruski, I.A. Chistovich, L.A. Chistovich, Kozhevnikova, Ryskina, Stolyarova, Sundberg & Lacerda, 1997). Vocalic properties are the main carriers

of prosodic information. There are three main components of the production of voice that are particularly important to the ability to produce the prosody of the adult languages: laryngeal tension, timing and subglottal air pressure. The development of control of these components is already marked out in the prelinguistic vocal behaviours (Vihman, 1996). According to Crystal (1979:37-45), five stages of prosodic development can be distinguished where children go from biologically determined vocalizations (stage I) through a period of awareness of prosodic contrasts in the ambient language (stage II), varied vocalizations (stage III), learned patterns of prosodic behaviour (stage IV) to “prosodic integration of sequences of items, usually two, into a single tone-unit” (stage V). This last stage is generally mastered around 18 months of age. The target prosodic structure of the ambient language is probably also of great importance for prosodic development. The predominant prosodic characteristics of the adult system are usually reflected in the infant productions. Hallé, Boysson-Bardies, and Vihman (1991) studied four infants each exposed to French (which has a preponderance of rising sentence intonation contours) and Japanese (with typically falling contours). The Japanese children produced a majority of falling level contours and the French children produced a majority of rising contours. Thus, a global effect of the dominant intonation pattern of the ambient language was found before the age of two years, and this was true for both lexical items and babbled utterances. In a study by So and Dodd (1995), it was found that children mastered the six tones of Cantonese before the age of two years. Moreover, the pattern of order and rate of acquisition were identical across children. There are few studies of prosodic acquisition in Swedish children. Engstrand, Williams and Strömquist (1991) showed that Swedish children were beginning to produce accent II-like F0 contours at 17 months and that they also used these contours to mark the appropriate words. In another study (Engstrand, Williams & Lacerda, 2003) it was shown that the accent II tonal word accent was perceptually distinct in the vocalizations of Swedish children at

the age of 18 months. Holmberg, Lawrischin and Sörensson (1971) found that Swedish children with typically developing language had acquired the contrast of the tonal word accents in an adult-like pattern by the age of five years. This is in accordance with a very recent study by Wells, Peppé and Goulandris (in press) where it was found that the ability to produce intonation in a functional manner was largely established in typically developing five-year-olds. However, it appeared that the age of acquisition of a specific prosodic ability may vary and some specific intonational features were not completely mastered until the age of eight (Wells et al, in press).

Some of the theories explaining the emergence of language that have been proposed have focused on the role of prosody. It has *inter alia* been proposed that prosodic cues in the speech directed to children provide a mode to separate units from each other, thus facilitating the discovery of the linguistic function of each unit. This process is referred to as “prosodic bootstrapping” (Bedore & Leonard 1995). Peters and Strömqvist (1996) explored this idea and they propose the so-called “spotlight hypothesis” which posits that learners focus on morphemes with perceptually salient prosodic patterns earlier than on morphemes not so “spotlighted” (Peters and Strömqvist, 1996:216). In a case study of a typically developing child, they found that he seemed to use prosodic patterns to learn, for example, inflected word forms. From their analyses of longitudinal data the authors conclude that the Swedish tonal word accents are acquired gradually. The role of consistency in the surface input was studied by Ota (2003) and it was shown that the most stable aspects of pitch phonology were acquired first, which is in accordance with the notion of prosodic bootstrapping and the “spotlight hypothesis”. In this article he also argues that a phonetic account of the development of pitch contours can be ruled out; according to Ota the development of pitch contours is a matter of pitch phonology.

Prosodic development is closely related to phonological development. Phonological development also undergoes considerable change during the first four years of age. The child's phonological organization goes from a stage where there is no specification in terms of vowel and consonant segments and their respective distinctive phonological features to an organization where vowels and consonants are specified segments with distinctive phonological features (Nettelbladt, 2004). Phonological ability also improves through increased capacity to produce adult sounds and combine them into more complex phonological structures (Ingram, 1979:133). According to Crystal (1979) the transition from prosodically varied vocalizations to phonology takes place during the second half of the child's first year. Phonological development and phonological problems can be explained through different theoretical perspectives. Nettelbladt (1983) made a division in paradigmatic and syntagmatic phonological processes. Paradigmatic processes are defined as context-free processes working on classes of segments. Syntagmatic processes are defined as processes that change the phonotactic structure of the target word and also the processes that affect prosodic features at the word level, such as syllable omissions and processes of tonal word accents. These processes result in a preference for a strong-weak (trochaic) pattern in the children's word productions (Nettelbladt, 1996). This trochaic bias can also be explained by the previously described metrical hypothesis originally proposed by Gerken (1991).

The concept of phonological processes was originally created within the framework of natural phonology (Stampe 1969; Ingram, 1976). A phonological process is always considered motivated by the physical character of speech. Most phonological processes are typical of normal phonological development and common in all children. Cross-linguistic studies have shown that some of the processes are universal and thus not language specific.

Of particular interest for the description of prosodic development are theories of nonsegmental phonology. In nonsegmental phonologies segments and features are viewed as independent. Features are organized into structured bundles and representations are minimally specified (Ball & Kent, 1997 and references therein). In autosegmental phonology, which is a branch within nonsegmental phonology, a single feature may be associated with one or more segments or possibly also with no segment. The need for autosegmental phonology originates from tonal phenomena, e.g. tone contours and tone stability (Goldsmith, 1979). Another non-segmental account of phonology is the underspecification theory (Ball & Kent, 1997). In this theory not all features can nor should be specified; some features are absent or underspecified. If a feature is not specified at the underlying level, it should not be available to trigger or block phonological rules. The theory can be applied on children's phonological processes.

Phonological development can also be viewed from a more articulatory perspective, as in gestural phonology (Kent, 1997). Gestural or articulatory phonology is distinguished from the other phonologies by its assertion that phonological representation is dependent on articulatory organization rather than on abstract features or other commonly assumed phonological units. Presumably, the crude gestures used in babbled speech would result in a more elaborated set of gestures suitable for the phonetic requirements of the ambient language. The appropriate coordination of these elaborated gestures could account for many aspects of phonological and prosodic development.

To summarize; irrespective of language there seems to be an emerging ability to use intonational contrasts from about 18 months. However, the productions of young children are variable and a complete adult system is not typically mastered until the age of five.

Prosody in Swedish children with language impairment

Swedish pre-school children with language impairment have difficulties in the acquisition of prosodic features at word level such as tonal word accent and word stress, as described by Nettelbladt (1983). She also found that syntagmatic phonological processes, defined as processes that either change the phonotactic structure of the target words or affect the correct production of tonal word accents, are particularly frequent in children with severe language impairment.

The influence of prosodic variables has been investigated in an experimental non-word task. In a study by Sahlén, Reuterskiöld Wagner, Nettelbladt and Radeborg (1999) it was shown that unstressed syllables were omitted six times more often in pre-stressed than in post-stressed positions of Swedish words and non-words.

K. Hansson (1998) explored grammatical problems in Swedish children with language impairment. Like children with other mother-tongues, they had problems in their use of grammatical morphemes. They omitted unstressed elements like articles and non-stressed pronominal sentence subjects which affects prosody at the phrase level (K. Hansson & Nettelbladt, 1995). These omissions could partly be explained by the so-called metrical hypothesis, mentioned above. In addition, the Swedish children also made errors of word order.

Semantic and/or pragmatic problems can also affect prosody, mainly at the discourse level. Sahlén and Nettelbladt described deviant prosody in two girls with semantic-pragmatic disorder (Sahlén & Nettelbladt, 1993). According to the authors these girls had unusual prosodic patterns, they lacked dialectal identity and one of them sounded particularly childish due to, for example, lack of

contrast of tonal word accent. However, no acoustic or perceptual analyses were made to verify the results.

Analyses

Within this thesis project new methods of analysis have been applied on LI in Swedish children. To provide a background, different types of methodology connected with the methods used, are described in the following section.

Perceptual evaluation

One way of assessing prosody is systematic perceptual evaluations made by naïve or expert listeners. In clinical assessment of prosody in children with language impairment, clinicians have so far exclusively relied on their own perceptual evaluation of clients. The clinician's evaluations are also rather unspecified; mainly an evaluation of whether a certain problem is heard or not. The perceptual impression is also crucial for listeners' acceptance of their speech. There are problems with perceptual analysis mainly regarding the lack of consensus of definitions, the reliability of perceptual judgements and the relevance of particular parameters for a particular disorder (Hartelius, 1997). However, it has been shown that the use of a protocol using fixed parameters did control for a large number of differences among listeners (Gerrat, Kreiman, Antonanzas-Barroso & Berke, 1993). Previous research has shown that perceptual evaluation by clinically well-trained listeners is reliable, if based on standardized rating procedures (Hammarberg, 1986).

In study I and II, prosody at the discourse level was assessed by the first author using a rating scale with three categories; where 0=no deviance; 1=borderline deviance and 2=obvious deviance. In study III, a panel of naïve listeners

assessed the children's ability to produce tonal word accents in an intelligible way. In study IV a panel of expert listeners; one with researchers in logopedics and one with phoneticians, evaluated the spontaneous speech of two children using a modified version of the set of perceptual rating dimensions developed at the Mayo Clinic Department of Neurology (Darley, Aronson & Brown, 1969) (accounted for in study IV). The protocol covers different aspects of speech production with a special focus on prosody. Also included were aspects of respiration, phonation, nasality and articulation. Studies using rating scales have shown that intra- as well as inter-rater reliability was different for different dimensions. It has also been argued that perceptual evaluations need to be completed with instrumental methods (Hartelius, 1997).

Acoustic analysis

Most of the studies of children where acoustic measurements have been used are focused on voice problems, mainly on perturbations manifested as hoarseness. It has been shown that acoustic perturbation measures provide relevant information correlating significantly with the perceptual impression (McAllister, 1997). However, there are rather few acoustic studies of phenomena related to linguistic aspects of children's speech, and even fewer of children with language impairment. Schwartz, Petinou, Goffman, Lazowski and Cartusciello (1996) studied young children's production of stress. Aspects analyzed were vowel duration, syllable duration, peak amplitude and peak fundamental frequency. They found that the children's stressed and unstressed syllables were less distinct than adults along each of the acoustic parameters. The ability of the children to produce stressed and unstressed syllables appeared to be subject to developmental change. Katz, Beach, Jenouri and Verma (1996) studied duration and fundamental frequency correlates of phrase boundaries in productions by both children and adults. Their results indicate that adults reliably control both duration and fundamental frequency to signal phrase boundaries. The children,

however, did not use any of the adult features to signal phrase boundaries. In a study by Dankovicova, Pigott, Peppé and Wells (in press) it is suggested that children start to use adult prosodic features somewhat earlier than argued by Katz et al. (1996). Dankovicova et al. (in press) used both acoustic measurements and perceptual evaluations to study how a group of ten 8-year-olds used temporal markers of prosodic boundaries. They found that the children used the features in the expected adult-like direction, when analyzed statistically at group level. A more detailed analysis at an individual level showed that there was considerable variability among children in their ability to mark phrase boundaries. The authors stress the importance of analyzing data at both the group and individual level. In another study of prosody in children's talk-in-interaction, acoustic measures of pitch and duration were used. The results verified that a child has prosodic means at his/her disposal that can be deployed among other things to project continuation of a turn by the age of 2;6 years (Wells & Corrin, 2003). Children with language impairment and age matched controls were examined by Snow (1998). He investigated whether they used final lengthening and final pitch movement to mark the end of a speech turn. He showed that both groups used final syllable lengthening to some extent, and all children had control of the final pitch fall. Snow (2001) also investigated the ability of children with language impairment to imitate rising and falling intonation contours. He found no differences between children with language impairment and age matched controls regarding this aspect of prosodic ability. In these studies, data was only analyzed at group level. According to the results of Dankovicova et al (in press), it seems plausible that some differences would have been found at the individual level. In this thesis acoustic analysis was used to study the productions of Swedish tonal word accents in children with LI (study III). In study IV acoustic analysis was made to verify and illustrate some of the prosodic features judged as deviant in the perceptual evaluations.

Phonological analysis

The phonological analysis was made in terms of phonological processes. A division between syntagmatic and paradigmatic processes was made in accordance with Nettelbladt (1983). Syntagmatic processes are defined as processes that change the phonotactic structure of the target word and processes that affect the production of tonal word accents. Problems with tonal word accents have been described as a phonological process called overgeneralization of accent II (Nettelbladt, 1983; Magnusson, 1983). In the terminology proposed by Ingram (1976), within the framework of Stampe (1969), syntagmatic processes correspond to assimilatory processes and syllable structure processes. Examples of syntagmatic processes are assimilation (a segment or feature of a particular segment triggers non-contiguous assimilation in another segment in a particular context) and dummy substitution (a vowel or a semantically empty syllable substitutes an omitted). Paradigmatic processes are defined as context-free processes working on classes of segments and they correspond to substitution processes in Ingram's terminology. Examples of paradigmatic processes are stopping and fronting.

The concept of overgeneralization originates from descriptions of grammatical development where it usually implies that children, in a phase of their development, extend a grammatical rule to cases where the rule is not applicable (Strömqvist, 1984). A systematic analysis of the tendency to overgeneralize certain grammatical forms was carried out by Berko (1958; Bishop, 1997), who tested children's ability to apply inflections when given nonsense words. A common phenomenon in language development is that children, at the beginning of the vocabulary spurt, use words for objects not only in the way adults do, but also for objects not normally named in this way. This is also seen as an overgeneralization/overextension (Strömqvist, 1984). The term has also been

used in describing phonological development, especially regarding tonal word accents (Nettelbladt, 1983; Magnusson, 1983).

Analysis of conversation

In study IV we have also made a detailed analysis of spontaneous speech samples. Analysis of spontaneous speech can be made in different ways. In a few earlier studies *Conversation analysis* (CA) methodology has been applied to analyses of children's conversation. In CA methodology the emphasis is on the collaborative nature of topic generation and every utterance is analyzed in relation to the context in which it occurs. How children use prosodic cues in talk-in interaction was investigated using CA in a study by Wells and Corrin (2003). This is a case study of one child in mother-child dyads where turn taking, especially transition relevance place (TRP), was investigated. The authors argue that using CA has potential to add new knowledge in the study of children's talk-in-interaction. Radford and Tarplee (2000) also used CA to analyze the speech of a 10-year-old child described as having pragmatic problems. They found that the subject was able to manage conversational topics but had difficulties in collaborating with his conversational partners. In another study (Tarplee & Barrow, 1999), CA was used to analyze conversations of a 3-year-old child with autism and his mother. It was shown that the child's echoes served him in important ways as a resource for engaging in reciprocal talk with his mother and that echoing has an important role in the co-construction of intersubjectivity. In Swedish studies of talk-in-interaction in children with language impairment the Initiative-Response analysis (Linell, Gustavsson & Juvonen 1988) has been used (Hansson, Nettelbladt & Nilholm 2000; Nettebladt & Hansson, 1993; Nettelbladt, Hansson & Nilholm, 2001). This is a method for analyzing spoken dialogues, designed to capture the dynamics, the coherence and the dominance conditions within a dialogue. One of the advantages with this

method is the possibility of making quantifications of the results, which can be useful in clinical research where there is a need for comparisons across individuals and over time. In study IV an analysis of spontaneous speech samples was made so that each turn of the children was analyzed in relation to the context in which it appeared. The analysis was made with special emphasis on mazes, coherence and co-construction of understanding (Anward, 1997;2003). The analysis of mazes was made in accordance with the procedure used in Nettelbladt and K. Hansson (1999).

The children's pragmatic abilities were also evaluated with the Swedish version of the Children's Communication Checklist, CCC (Nettelbladt, Sahlén & Radeborg, 2003). The CCC was developed by Bishop (1998) to assess aspects of communicative impairment that are not adequately evaluated by standardized language tests in current use, predominantly pragmatic problems seen in social communication (Bishop, 1998).

Aims of the present study

The overall aim of this study was to explore prosody, in particular prosodic problems in Swedish children with LI. To this end a comprehensive assessment procedure was developed.

More specifically the aims were:

- to investigate the validity and reliability of the newly developed assessment procedure. A more specific aim was to obtain an estimate of the prevalence of prosodic problems by applying it on a population of Swedish children with LI not selected for having prosodic problems

- to characterize a group of children with prosodic problems and compare them to children with typical language development and to investigate the possibilities of classifying subgroups of prosodic problems
- to investigate the ability to produce contrasts of tonal word accents in Swedish children with language impairment and known prosodic problems
- to further explore prosodic problems at discourse level in two children with language impairment and possibly also pragmatic problems

Method

Subjects

The subjects belong to two different populations. The first is a group of 29 children with language impairment attending two pre-schools specialized in language problems (accounted for in study I). The second is a population of 25 children with LI and some kind of prosodic problems as assessed by their respective clinician, and 25 control children matched to age, gender and regional dialect (accounted for in study II & III). The subjects were recruited from three different dialectal areas. The subjects were included according to very wide criteria. A few subjects with neuro-psychiatric disorders and one subject with pervasive developmental disorder were participating in the study. For an overview of the subjects, see table 1 & 2.

Table 1. Overview of the subjects in study I.

Children	Boys	Girls	Age range	Mean age
29	24	5	4;6-7;6	6;1

Table 2. Overview of the subjects in study II & III.

Group	Boys	Girls	Age range	Mean age
LI	16	9	4;4-10;0	5;11
Controls	16	9	4;4-9;8	5;9

Two of the children in the latter group have been analyzed regarding prosodic problems at discourse level (accounted for in study IV). For an overview, see table 3.

Table 3. Overview of the subjects of study IV.

Child	Gender	Age at first recording	Age at second recording
A	Girl	6;6	9;0
B	Boy	6;1	9;9

Pretesting of both populations included tests for language comprehension, grammatical abilities and oral motor skills. Language comprehension was tested with the Swedish Test of Language Comprehension (SIT, Hellquist, 1989). This test includes items that deal with grammatical forms such as different tense forms of verbs, pronouns, prepositions, conjunctions and negation. Grammatical production was tested with the Lund test for phonology and grammar (Holmberg & Stenqvist, 1978). Tasks assessing plural forms, genitives, prepositions, negation and verb tense were selected (tasks 27-66). Oral motor skills were tested with a shortened version of ORIS (Holmberg & Bergström, 1996). ORIS gives a status of oral motor and articulatory function.

Assessment procedure

A test to capture prosodic features at the word, phrase and discourse levels has been designed as part of this thesis (accounted for in study I and II). The test has 12 subtests and it takes about one hour to administer. A rather formalized

procedure for conversation and narration has been set up to ensure that the conversation and narration parts of the assessment are as comparable as possible across participants. In order to elicit the target structures at word and phrase level, the test uses different strategies, such as direct questions, sentence completion and model strategy (Nettelbladt 1995).

Analyses

In study I and II all subtests were transcribed phonetically with narrow phonetic transcription, except the subtests on conversation and narration (1 & 12), which were transcribed orthographically. The children received 1 point for each prosodically correct production of the target structure. The subtest on phonology (2) was also analyzed in terms of phonological processes. In study III perceptual evaluation by naïve listeners and acoustic analysis of F0 contours were used. In study IV perceptual evaluation by expert listeners, acoustic analysis, children's communication checklist, CCC, (Bishop, 1998) and analysis of spontaneous conversation and narration were made.

Reliability

For study I the transcriptions and the scorings for all participating children were carried out by the second author and then checked by the first author on an item-by-item basis. The inter-examiner agreement was 75%. The two judges had very diverging opinions on one Subtest (Subtest 3) for one child. If this Subtest for this child was excluded the inter-examiner agreement amounted to 95%. For the phonetic transcription, the inter-examiner agreement was 92%. For study II the transcriptions and scorings for both the children with LI and the matched controls were carried out by the first author and 30% of the material was checked by the second author. The inter-examiner agreement of the procedure as a whole was

96.4%. Subtest 2 (phonology) was transcribed in its entirety also by the second author and the inter-examiner agreement was 96.1% for the children with LI, 99.5% for the control children and 97.8% for the two groups together. The second author also made the analysis of phonological processes independently of the first author. The results were compared and in cases of disagreement the authors arrived at a consensus on which process to choose.

In study III the perceptual scoring was made by ten naïve listeners. The inter rater agreement, measured by Cronbach's alpha, was 0.66, which is just below the recommended value of 0.7, but the scale only comprised two levels which tends to result in low values. This study also contains an acoustic evaluation by visual examination of spectrograms. This evaluation was made blindly twice by the first author and the intra-examiner agreement was 87%.

In study IV the perceptual evaluation was made by two groups of expert listeners; one including researchers in logopedics specialized in child language impairments, the second including phoneticians. Inter rater agreement measured with Cronbach's alpha was .80 for researchers in Logopedics and .81 for phoneticians; for researchers in Logopedics and phoneticians together Cronbach's alpha was .90.

Statistical analyses

For correlations, the regular Pearson's r as well as the non-parametric Spearman's correlations were used. The Cronbach's alpha was used both to calculate reliability of the assessment procedure and to calculate inter rater reliability. In study I, a t-test for equality of variances for presence vs. absence of prosodic deviance at discourse level was performed in order to calculate the

validity of the assessment tool. A t-test was also used to calculate the differences between children with different language diagnoses. A test for comparing elements of a correlation matrix was created for the correlation between syntagmatic processes and total score on the one hand, and the correlation between paradigmatic processes and the total score on the other (Stieger, 1980). In study II the comparison of the two groups, children with LI and controls, was made with the Mann-Whitney U test.

Results

Study I

The main purpose of study I was to investigate reliability and validity of the assessment procedure of prosody developed within the scope of this thesis. Twenty-nine children attending pre-schools specialized in language intervention participated in the study. They were not selected for having prosodic problems, which gave us an opportunity to estimate the prevalence of prosodic problems in a population of Swedish children with LI. By perceptual assessment 41% of the participating children were considered having prosodic problems to some extent. The reliability of the procedure as measured by Cronbach's alpha and the inter-examiner agreement measured in percent, proved to be sufficiently high. To obtain an indication of the validity of the procedure, the perceptual scoring of prosodic problems at the discourse level was compared to the score of the rest of the procedure. The children perceptually identified as having some kind of prosodic problems at the discourse level scored significantly lower than the children without prosodic problems at the assessment procedure. This might be an indication that the assessment procedure is a valid instrument to capture prosodic problems in Swedish children with language impairment.

The total test-score significantly correlated with grammatical abilities and language comprehension. This suggests that prosodic problems might be related to the severity of language impairment. Low scores on the assessment procedure were also related to a large number of syntagmatic phonological processes, i.e. context-sensitive processes that change the phonotactic structure of the target words. However, it is important to point out that prosodic problems at the word level overlap with some of the syntagmatic phonological processes, e.g. syllable omissions and lack of contrast of tonal word accents.

A further result was that the type of language impairment, i.e. expressive or receptive, diagnosed by the clinicians treating the children, contributed to the outcome of the procedure. The children with expressive language impairment scored significantly higher than the children with receptive language impairment. This indicates that prosodic problems are more salient in the diagnosis receptive language impairment than in the diagnosis expressive language impairment. The study supports the assumption of a perceptual component in prosodic problems.

Study II

The aim of study II was two-fold. The first was to characterize a group of children with known prosodic problems compared to children with normal language development matched to age, gender and regional dialect. The second aim was to investigate the possibilities of classifying subgroups of prosodic problems. The comparison of cases and controls, made by the non-parametric Mann-Whitney U test, showed that the difference between the cases and the controls was highly significant for all the subtests of the assessment procedure. By comparing the results of the prosodic assessment procedure with other aspects of language it was shown that prosodic problems also occur in children with less severe LI.

As prosodic problems at the word level are also manifested as phonological processes, in particular syntagmatic processes, a thorough phonological analysis was carried out. The number of syntagmatic and paradigmatic phonological processes significantly correlated with the total score of the procedure.

The prosodic problems of the children with LI can be grouped according to word, phrase or discourse level. Of the children with LI, 33% had prosodic problems mainly at the word level, 42% had prosodic problems at both the word and phrase levels and 17%, were identified as having prosodic problems mainly at discourse level. Two of the children with LI, 8%, did not score exceptionally low on any subtest. The results indicate that problems at the word and phrase levels seem to co-occur. It seems as if prosodic problems at only word or at both word and phrase level are a matter of severity. The results also indicate a possible differentiation in two separate subgroups, one with prosodic problems primarily related to phonetic and/or linguistic problems, and a second subgroup with prosodic problems at discourse level possibly related to pragmatic problems.

Study III

Study III was designed to examine the production of the Swedish tonal word accents in children with language impairment and normal controls matched to age, gender and regional dialect. The results showed that 60,8% of the children with language impairment had difficulties producing the contrast of tonal word accents according to the F0 patterns. The deviant F0 patterns showed overall flattened curves. The difference in the rating of the F0 curves between the children with LI and their matched controls was significant. The perceptual evaluation showed that the listeners' perception of accent I or accent II agreed with the intended accent type in 62% of the words. There was a significant positive correlation between the perceptual results and the F0 rating, indicating

that the better a child was perceived, the better his/her F0 production was rated. About the same percentages of the production of the two accents were correctly identified by the listeners, 56% and 66% for accent I and II, respectively. A t-test of the correctly identified production did not show any difference between accent I and II. Thus, according to these results the previously described overgeneralization of accent II (Nettelbladt, 1983; Magnusson, 1983) could not be verified. The problem with the production of the tonal word accents is more a lack of distinction between the accents than a substitution of one accent for the other.

Study IV

In a previous study it was shown that there was a group of children with language impairment (LI) that have prosodic problems primarily at the discourse level (Samuelsson & Nettelbladt, 2004). To further explore the possible relationship between prosodic and pragmatic problems two children with prosodic and possibly pragmatic problems in combination were studied at two occasions. The children's prosodic abilities were evaluated by the previously described assessment procedure for prosody, by perceptual evaluation by expert listeners and by acoustic analysis. Their pragmatic abilities were assessed with analysis of spontaneous speech samples and the CCC. Both children scored rather high on the prosody assessment procedure. In spite of this they were considered rather deviant on several parameters of the perceptual evaluation, e.g. vocal fry, repetitions, pitch variations and dialectal specificity. The perceptual evaluation showed rather good inter-rater agreement for both researchers in logopedics and phoneticians. The acoustic analysis verified some of the parameters that were perceived as deviant in the perceptual evaluation, e.g. vocal fry and pitch variations. The spontaneous speech samples of both children contained sequences that indicate pragmatic and/or semantic problems such as tangential answers and echolalic behaviour. The evaluation of pragmatic

difficulties made by CCC showed that both children had some pragmatic problems as assessed by both teachers and parents, but neither of them scored above the cut off on the pragmatic composite. However, there was a considerable discrepancy between the score on the CCC and the scores on standard language tests, which indicates that these children have pragmatic problems that could not only be explained by language impairment.

Summary of results

To explore prosody in Swedish children with LI, a comprehensive assessment procedure to capture prosody at word, phrase and discourse level was designed. This procedure was also shown to be sufficiently reliable and valid. The results showed that c:a 40% of Swedish children with LI at pre-schools specialized in language problems, have prosodic problems to some extent. In a population selected for having unspecified prosodic problems, as assessed by their clinician, at least two different subgroups of prosodic problems can be characterized; one with prosodic problems related to linguistic/phonetic problems at the word and/or word and phrase level, and the other possibly related to pragmatic problems. In the case study of two children the assumption of a link between prosodic and pragmatic problems was supported. Children with typical language development do not have any particular prosodic problems except for some difficulties with tonal word accents among the young children. Contrast of tonal word accents was also one of the most difficult prosodic features for children with LI in combination with prosodic problems to acquire. This was verified by detailed perceptual and acoustic evaluation.

General discussion

In this thesis it has been shown that Swedish children with LI have prosodic problems to a surprisingly large extent. The results also indicate that prosodic problems occur at different levels of language and that they probably have different aetiologies.

In study I, it was shown that prosodic problems are frequent in Swedish children with LI and that the problems occur at the word, phrase and discourse levels. As the total test-score significantly correlated with grammatical abilities and language comprehension it was tentatively suggested that prosodic problems might be related to the severity of language impairment in accordance with the results shown by Nettelbladt (1983). However, according to our clinical experience, prosodic problems also occur in less severe cases. In study II, where the children were selected for having prosodic problems to some extent, the correlation with other aspects of language impairment was not as strong. This supports the assumption that prosodic problems exist as a symptom also in children with less severe language impairment, as prosodic problems occur in children with milder problems with other aspects of language. The study of the medical records also indicate that the prosodic problems in these children might be residual symptoms of a previously more severe LI. In addition, the results of study II suggest that the significant correlation between the total score of the procedure and grammatical abilities on the one hand, and phonology on the other, could be an expression of a link between phonological abilities, grammatical abilities and prosodic abilities. The results, however, show that the children either have problems at the word level only, at the word and phrase levels, at the word, phrase and discourse levels, or at the discourse level only. Probably, there are also developmental aspects in the different levels of prosodic problems. It can be assumed that a child could develop from having

had problems at both the word and phrase level to have problems at the word level only. There were no children who had problems at the phrase level only. The children that omit unstressed elements at the phrase level, e.g. copula, also omit unstressed syllables in single words. One can speculate whether the omissions of unstressed elements could be interpreted as a rhythmical problem rather than a syntactical problem. This may indicate that the link between phonology and prosody is perhaps stronger than the link between grammar and prosody. Nevertheless, the syntax is obviously affected by these rhythmical constraints.

In study I and II detailed phonological analysis in terms of phonological processes was made. This kind of analysis was chosen mainly because this is in accordance with current Swedish clinical practice but also because this type of analysis covers some prosodic features at the word level such as syllable omissions and problems with tonal word accents. In study I it was shown that low scores on the assessment procedure were related to a large number of syntagmatic phonological processes, i.e. context-sensitive processes that change the phonotactic structure of the target words. However, it is important to remember that prosodic problems at the word level overlap with some of the syntagmatic phonological processes, e.g. syllable omissions and overgeneralization of tonal word accents. In study I, as well as in a study by Hansson and Nettelbladt (2002) the most frequent phonological processes in children with LI were weakening, mostly of /r/, and reduction of polysyllabic words. In study II, the most frequent phonological process was problems with tonal word accents. It is important to bear in mind that the subjects in study II, III and IV were children especially selected for having prosodic problems. Problems with tonal word accents seem to be one of the core problems in children with prosodic problems. This was further explored in study III. It was shown that problems with tonal word accents were prominent in Swedish

children with LI when acoustic measurements and perceptual evaluation by ten naïve listeners were performed. One of the main new contributions of study III was that the previously suggested overgeneralization of accent II could not be verified. On the contrary, it was shown that the problems rather concern the lack of contrasts between the two accents than an overgeneralization of one of them. In a comparison of Japanese and Swedish children, Ota (2003) studied the data from Engstrand et al. (1991) and found that some Swedish children produce disyllabic words with little F0 movement on the first syllable but a rise into the second syllable. This offers a possible explanation of why some accent I produced by young children are heard as having accent II by adult Swedish listeners (Ota 2003). However, in the perceptual evaluation by naïve listeners in our study, the listeners did not hear accent I as accent II to a larger extent than vice versa. According to our experience, Swedish clinicians find overgeneralization of accent II difficult to assess in terms of a phonological process, which might reflect that this is not a true overgeneralization. These results points to the importance of a separation of the phonological level and the phonetic level in clinical work with children with LI. When treating children with e.g. problems with tonal word accents focus should be on acquiring the contrast of accents, not only on working with one of the accents.

A further result from study I was that the type of language impairment, i.e. expressive or receptive, diagnosed by the clinicians treating the children, contributed to the outcome of the assessment procedure of prosody developed for this thesis project. The children with expressive language impairment received a significantly higher total score than the children with receptive language impairment. This indicates that prosodic problems are more salient in the diagnosis receptive language impairment than in the diagnosis expressive language impairment. These results support the assumption of a perceptual component in prosodic problems. This is consistent with the perceptually based

model of children's early production proposed by Echols (1993) where she found that prosodic salience of elements such as stress or lengthening contributes to the form of early production. In study II no significant correlations between diagnosis and result on the procedure were found, which might be due to the fact that the inclusionary criteria for study II were broader and that the proportion of children with phonological LI, F80.0 according to ICD-10, was larger. The present study did not include any tests for comprehension and discrimination of prosodic contrasts. However, our main focus was on production of prosodic aspects. To be able to cover as many aspects of production of prosody as possible we had to limit the scope of the assessment procedure. Tests of discrimination of prosody have earlier been found to be especially problematic also in children with typical language development at four and seven years of age (Harsten, Nettelbladt, Schalén, Kalm, & Prellner, 1993). It is, however, an interesting aspect of prosody and would be an important topic of future studies.

Children with prosodic problems primarily at the discourse level were found in both study I and II, and in study II it was tentatively suggested that these problems might be related to pragmatic problems. For study IV, two children with prosodic problems at the discourse level were selected for further investigation. Spontaneous speech samples from these children were analyzed by perceptual evaluation by expert listeners, acoustic analysis of certain parameters, and analysis of spontaneous speech. In addition the CCC was distributed to both their parents and their teachers. It was found that all the expert listeners judged both children as deviant on several prosodic parameters, e.g. vocal fry, repetitions, pitch variations and dialectal specificity. The acoustic analysis verified some of the parameters that were perceived as deviant in the perceptual evaluation, e.g. vocal fry and intensity variations. Through the perceptual evaluations and acoustic analysis it was shown that both children had

prosodic problems at the discourse level. Analysis of spontaneous speech samples and CCC also verified that they had pragmatic problems to some extent. In contrast, the assessment procedure of prosody showed that they did not have prosodic problems at word or phrase level. This supports the suggested division of prosodic problems into two subgroups; one comprising prosodic problems related to phonetic and/or linguistic deficits mainly at the word and phrase levels, and the other comprising prosodic problems related to pragmatic problems mainly at the discourse level.

The fact that prosodic problems at the discourse level were not detected at the word and phrase levels in these two children might be seen as a manifestation of the elusiveness of prosodic features at the discourse level. However, the problems at the discourse level were perceived by both groups of listeners and also, to some extent, verified by the acoustic analysis. These two children seem to have problems in prosodic agreement with their conversational partner which might reflect general problems in adapting and relating to other people. As prosodic cues are very important to the ability to express ourselves in an understandable way, prosodic problems at the discourse level can cause major problems in conversation. This study is a first step towards describing prosodic phenomena at the discourse level in a systematic way.

One of the theoretical accounts explaining LI in children is the surface hypothesis (Leonard, 1998). Within this view the prosodic problems in the children with LI could be regarded as a consequence of limitations in the perception of elements with low phonetic substance. This fits nicely with the results of the children with prosodic problems at the word and phrase level. According to the sparse morphology account, prosodic problems would be lesser in Swedish children as Swedish is a language where prosody carries a lot of information relevant to the interpretation of utterances. This was, however, not

the case. On the contrary, prosodic problems seem to be more frequent in Swedish children with LI than in, for example, English speaking children, as assessed by Wells and Peppé (2003) which provide further support for the surface hypothesis. Thus one may presume that prosodic problems are more salient in a language like Swedish where prosody plays such a crucial role for intelligibility. Yet, it would be of great interest to make cross-linguistic comparisons of prosodic features in children with LI to further investigate the underlying factors of prosodic problems.

This thesis is a first step in the study of prosody in Swedish children with LI. It's exploratory character calls for the use of different methods for analysis of prosody and great effort has been made to develop methods for assessment of prosody in children with LI. For study I and II a comprehensive assessment procedure of prosody at the word, phrase and discourse levels was developed. This procedure was found to be valid and reliable and at least parts of it might be a useful tool in the clinical assessment of prosody in children with LI. However, in research on prosody the procedure needs to be complemented with further analysis. In study III and IV we used perceptual evaluation with listeners' panels and acoustic measurements. To evaluate the relationship between pragmatic and prosodic abilities, which was one of the aims of study IV, we also used analysis of spontaneous conversation and narration. The acoustic analyses are important to verify and illustrate the results from both the assessment procedure and the perceptual evaluation. In the study of production of tonal word accents the acoustic evaluation was absolutely necessary to verify the conclusion that there is no true overgeneralization of accent II, contrary to earlier descriptions (Nettelbladt, 1983). However, acoustic measurements need to be used in further studies to obtain referential data for evaluating, e.g. F0 contours in spectrograms.

The goal of communication is mutual understanding and intelligibility is a good indicator of overall severity. In study III we used a panel of naïve listeners. They only needed to choose the target word among two alternatives (accounted for in study III) which gives an estimate of the extent to which the children managed to convey the correct perception of a word. In perceptual evaluations of this kind naïve listeners seem adequate, since the children primarily communicate with non-trained listeners. The aim of study IV was to study prosodic problems at the discourse level in two children with pragmatic problems and for this purpose we used two panels of expert listeners; one with researchers in logopedics, who specialize in child language impairments and one with phoneticians. In this study we wanted to conduct an evaluation not only of intelligibility, but also of certain prosodic parameters. To make this evaluation as reliable as possible a protocol was used and we choose expert listeners, as the ability to judge the parameters on this protocol requires expert knowledge.

Prosodic problems are symptoms occurring in several speech and language diagnoses and at different levels of language. In this thesis, the focus is on prosody, elucidated from various perspectives and in relation to different language diagnoses. Classification of language impairment is problematic. In a recent paper, Law (2004:401) states “There is something so intrinsically appealing about the concept of a discrete language difficulty that many authors have overlooked that the defining of language impairment is at best an imprecise art that is still highly dependent on measurement of constructs about which we know so little”. Starting out from a symptom, like prosodic problems, the perspective on classification is somewhat different than if one regards language impairments as discrete categories. The results from this thesis suggest that some of the language diagnoses categorized in ICD 10 are interrelated and that prosodic problems occur in several of them. In the previous International Classification of Diseases, ICD 9, the system of classification was based on

symptomatology and this system permitted a number of combination possibilities according to the most salient symptoms. ICD 9 also gave a possibility to take aetiology into consideration when choosing the diagnosis; in ICD 10 aetiology is not taken into account in the diagnoses. A system with a greater inbuilt freedom of combinations is more flexible and it is probably more fruitful to adopt a dimensional view on diagnosing children with LI than to divide them into discrete categories according to a single gold standard. According to Bishop (2004:322), “The pure, clear-cut categories described in textbooks bear little relation to clinical reality”. In a recent study, the CCC was used to differentiate between children with specific language impairment (SLI), children with pragmatic language impairment (PLI) and children with autism (Frazier Norbury, Nash, Baird & Bishop, 2004). The results showed that there was considerable overlap between groups and it was concluded that pragmatic ability is affected by linguistic skill, autistic-like behaviour, attention and social cognition. In the earlier mentioned study the pragmatic problems in children diagnosed with SLI appeared to be even more significant than previously reported (Bishop, 1998). This lends further support to the idea of a dimensional view on communication problems rather than continuing to think categorically.

From a historical perspective, it is clear that views on the diagnosis of language impairments in children have changed over time, and a classification system that allows flexibility has greater potential to make new research findings come into clinical use. When diagnosing children with LI the purpose of the diagnosis must be taken into consideration. The consequences of the impairment may also vary in different situations. For research purposes a stringent definition of diagnoses is necessary, but in clinical work the goal is rather to identify children whose language impairments affect their everyday life. The ICF system mentioned previously takes affection on everyday functioning into consideration. This

makes it a useful complement in the clinical work with diagnosing children with language impairments.

Refined methodology and increased detail in assessing prosodic problems may give new insight to our knowledge about Swedish children with LI. Previous research on Swedish children with LI has almost exclusively been carried out in the South of Sweden. When assessing prosody it is important to take the role of regional dialects into consideration. This thesis can contribute with new knowledge as we choose children from different dialectal areas. In future studies, it would also be interesting to investigate data from additional dialectal areas.

Conclusions

The overall aim of this thesis was to explore prosodic problems in Swedish children with language impairment. It has been shown that prosodic problems are frequent in Swedish children with LI. In addition, it has been possible to differentiate prosodic problems in different subgroups according to the linguistic level at which they occur as well as according to possible aetiologies. New methodologies have been used and the results point to the importance of using different methods in assessing prosody. Future studies will continue to develop these methods.

Swedish has a complicated prosodic system and the results from this study might indicate that prosodic problems are more salient and perhaps also more prevalent in Swedish than in languages where prosody carries less information relevant to the interpretation of the spoken message. Future studies with cross-linguistic comparisons of prosodic features would be of great interest.

Classification of language impairments is problematic and the results from the present work have shown that prosodic problems occur in several language diagnoses. These results provide additional support for the idea of a dimensional view on language impairments.

Svensk sammanfattning

(Summary in Swedish)

Prosodi definieras som talets rytmiska, dynamiska och melodiska egenskaper (Bruce, 1998). Till de prosodiska dragen hör längd (kvantitet), betoning (tryck- och ordaccent), ton, satsmelodi (intonation) och gränser (tomrum i talvågen). Dessa drag används i kommunikativt syfte för att särskilja betydelser hos ord och

orddelar, för att framhäva och gruppera delar av talet och för att ange talhandling (t.ex. påstående, fråga, utrop) och mera emotionella aspekter av kommunikationen som attityd och social tillhörighet. Prosodin spelar stor roll när det lilla barnet lär sig ett språk, man hör redan i jollret att barnen härmar de vuxnas satsmelodi. Kliniskt uppges avvikande prosodi av logopedier ofta som mera svårdiagnostiserat än andra symtom vid språkstörning.

Tidigare forskning har bland annat visat att svenska barn med språkstörning har svårigheter att lära sig att behärska svenskans ordaccenter, t.ex. "Oskar" kontra "åskar", och ord med sen betoning, t.ex. "apelsin" blir "sin" (Nettelblatt, 1983). Barn med grav språkstörning har ofta även problem att utveckla sin grammatik och utelämnar småord som prepositioner och artiklar liksom ändelser (Hansson, 1998; Hansson & Nettelblatt, 1995), vilket påverkar rytmen i talet. Forskare har förklarat denna typ av förenklingar utifrån den s.k. metriska hypotesen, som antar att barnet eftersträvar en bestämd talrytm som innebär en växling mellan betonade och obetonade stavelser, en trokérytm (Gerken, 1991; Nettelblatt 1998b). Obetonade stavelser som inte passar in i mönstret utelämnas. Vilken rytm som eftersträvas är emellertid beroende av vilket språk som talas i omgivningen. För t.ex. franska barn blir mönstret ett annat beroende på att franskans mönster snarare är jambiskt. Man har även undersökt förmågan hos barn med språkstörning att uppfatta prosodiska kontraster i s.k. nonord (ord som saknar betydelse men som är fullt möjliga ord, t.ex. gly'vå) som ett sätt att undersöka auditivt minne. Resultaten har visat att betoningsmönstret är kritiskt för om ett barn kan uppfatta ordet; ord med tidig betoning är signifikant lättare än ord med sen betoning (Sahlén, Reuterskiöld Wagner, Nettelblatt & Radeborg, 1999).

Det övergripande syftet med detta arbete är att kartlägga prosodi, i synnerhet prosodiska avvikelser, hos svenska barn med språkstörning. För att kunna

genomföra detta har ett omfattande undersökningsmaterial för prosodi på ord-
fras- och textnivå konstruerats. Mera specifika mål är

- att undersöka validitet och reliabilitet för det utarbetade undersökningsmaterialet samt att undersöka prevalens av prosodiska problem i en population svenska barn med språkstörning
- att beskriva en grupp barn som enligt behandlande logoped har en språkstörning i kombination med prosodiska problem. Dessa barn jämfördes med en kontrollgrupp. Ytterligare syfte var att undersöka möjligheterna att klassificera undergrupper av prosodiska avvikelser
- att undersöka förmågan hos svenska barn med kända prosodiska problem att producera hörbara kontraster mellan ordaccenterna
- att undersöka prosodiska problem på textnivå hos två barn med språkstörning i kombination med pragmatiska problem

I de fyra artiklarna redovisas data från totalt 79 barn, 29 barn med språkstörning på språkförskolor i Mellansverige, 25 barn med språkstörning i kombination med prosodiska problem och 25 kontrollbarn matchade till ålder, kön och dialekt. Tidigare forskning om språkstörning hos svenska barn har huvudsakligen behandlat skånska barn. Två av artiklarna behandlar resultat från det undersökningsmaterial som utarbetats inom ramen för avhandlingsarbetet. Undersökningsmaterialet fångar prosodi på ord-, fras- och textnivå. Materialet har 12 deltest och tar c:a 60 minuter att genomföra. Flera eliciteringsstrategier används; benämning av bilder, direkta frågor, ifyllnadsstrategi och modellmening. I undersökningsmaterialet ingår även ett videoavsnitt till vilket barnen ska berätta samtidigt som filmen visas (Samuelsson, 2001).

I studie I undersöktes 29 barn från två språkförskolor i Mellansverige med ovan beskrivna undersökningsmaterial. Resultaten visade att undersökningsmaterialets validitet och reliabilitet är tillfredsställande. Eftersom barnen i studie I utgjordes

av en population barn med språkstörning som inte selekterats för prosodiska avvikelser kunde även slutsatser om förekomst av prosodiska problem dras. Resultaten visade att c:a 40% av barnen hade prosodiska problem i viss utsträckning. Vi fann även att barnen hade prosodiska problem på såväl ord- som fras- och textnivå.

I studie II ingick 25 barn med språkstörning i kombination med någon form av prosodiska problem enligt behandlande logoped och 25 barn med normal utveckling matchade till ålder, kön och dialekt. Barnen rekryterades från tre olika dialektområden. Undersökningsmaterialet för prosodi användes och proceduren spelades in samt transkriberades i sin helhet. Därefter analyserades och poängsattes materialet. Resultaten visade signifikanta skillnader mellan fall och kontroller beträffande samtliga prosodiska parametrar. Prosodiska problem förekom på enbart ordnivå, ord- och frasnivå, ord-, fras- och textnivå samt på enbart textnivå. Prosodiska problem enbart på frasnivå förekom inte. Resultaten tydde även på att prosodiska problem kan delas in i åtminstone två undergrupper; dels prosodiska problem på ord- och/eller ord- och frasnivå relaterade till språkliga eller fonetiska svårigheter, dels prosodiska problem på textnivå relaterade till pragmatiska problem.

Det enskilda prosodiska drag som vållade störst problem för barnen med språkstörning i kombination med prosodiska problem var ordaccentkontraster. I studie III analyserades barnens förmåga att producera hörbara kontraster mellan ordaccenterna med lyssnarbedömning av naiva lyssnare samt med akustiska mätningar. Resultaten visade att naiva lyssnare hade stora svårigheter att uppfatta vilken accent som producerades. Visuellt besiktning av F0-kurvor av barnens produktion visade också att barnen med språkstörning och prosodiska problem inte åstadkom förväntat F0-mönster i 60,8% av fallen. Det fanns även en signifikant korrelation mellan korrekt uppfattat ord och förväntat F0-mönster.

Resultaten ställdes i relation till det tidigare föreslagna antagandet om att detta rör sig om en övergeneralisering av accent II. Vi fann emellertid att problemen snarare rör sig om en avsaknad av accentkontrasterna än en övergeneralisering av accent II.

Studie IV är en fallstudie av två barn med prosodiska problem på textnivå och pragmatiska problem. Barnen bedömdes med lyssnarbedömning av expertlyssnare; logopeder (med forskningsinriktning på barn med språkstörning) och fonetiker. Lyssnarbedömningen kompletterades med akustiska mätningar. För att bedöma barnens pragmatiska förmåga distribuerades svenska CCC (Nettelbladt, Sahlén & Radeborg, 2003) till de två barnens lärare och föräldrar. Samtalsanalys av spontan konversation och narration genomfördes också i syfte att studera pragmatik och prosodisk anpassning. Resultaten visade att barnen bedömdes som avvikande beträffande flera prosodiska parametrar av samtliga lyssnare. Interbedömarreliabiliteten mellan lyssnarna var god. Lyssnarbedömningens resultat kunde verifieras av akustiska mätningar beträffande vissa parametrar, bl a monoton och knarr. Resultaten visade också att båda barnen hade pragmatiska problem även om inget av dem föll under gränsvärdet för språkliga/kommunikativa problem enligt CCC:s svenska manual. Barnens prosodiska problem på textnivå antas vara beroende av deras pragmatiska problem eftersom båda barnen uppvisar relativt god prosodisk förmåga på ord- och frasnivå.

Prosodiska problem är inte en diagnos i sig utan symptom som förekommer på samtliga språkliga nivåer och vid flera språk- och taldiagnoser. Detta innebär ett annorlunda perspektiv än i tidigare svensk forskning om barn med språkstörning. I avhandlingens diskussion argumenteras för ett dimensionellt tänkande vid diagnosticering av barn med språkstörning snarare än att klassificera barnen i

strikt kategorier, vilket blir fallet med nuvarande klassifikationssystem och diagnosförteckning.

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